MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 2, 2017/2018

EEL1196 – INSTRUMENTATION & MEASUREMENT TECHNIQUES

(All Sections / Groups)

02 MARCH 2018
3:00 P.M – 5:00 P.M.
(2 Hours)

INSTRUCTIONS TO STUDENT

1. This Question paper consists of 6 pages including cover page with 4 Questions only.
2. Attempt **ALL FOUR** questions. All questions carry equal marks and the distribution of the marks for each question is given.
3. Please write all your answers in the Answer Booklet provided.

Question 1

(a) Define the term 'Sensitivity'. Explain the importance of knowing an instrument's sensitivity.

[3 marks]

(b) A circuit is set up as shown in **Figure Q1(b)**. Ammeter A is used to measure the current flowing through R_1 and R_2. Given that $R_1 = R_2 = 1k\Omega$, and $R_3 = 3k\Omega$ and the internal resistance of ammeter A is 100Ω.

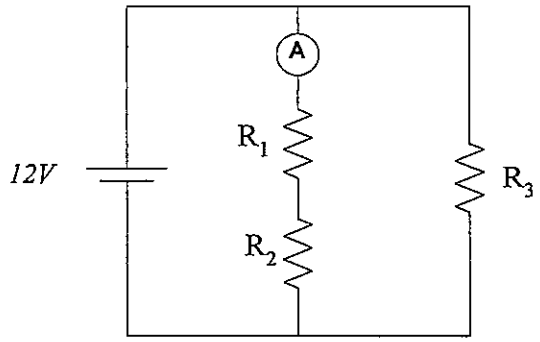

Figure Q1(b)

i) Calculate the true value of the current flowing through R_1 and R_2.

[3 marks]

ii) Calculate the current value as measured by ammeter A, taking into account its internal resistance.

[3 marks]

iii) Determine the % relative error and accuracy of the ammeter reading.

[2 marks]

iv) What type of error is this? Suggest one way to reduce this error.

[2 marks]

(c) Determine the dimension of torque. [2 marks]

Continued...

Question 2

(a) What is the meaning of *"F"*, *"B"* and *"I"* in Left-hand Fleming Rule? Briefly explain the role of these terms in a moving indicating instrument. [2 marks]

(b) The coil of a PMMC ammeter has a length of *2cm* and width of *3cm*, and has 50turns wound on it. The control spring exerts a torque of $3\times10^{-4}Nm$ it has a full scale deflection of 20 divisions on the scale of the meter. The magnetic flux density in the air gap is $1Wb/m^2$, and the coil has a resistance of $1k\Omega$.

i) Calculate the maximum current in the form of *A/div* that can be measured by the ammeter. [2 marks]

ii) Estimate the resistance that must be put in parallel with the coil to increase the maximum current measurement in Part (b)(i) to *2.5mA/div*. [2 marks]

iii) Based on Part (b)(ii), determine the current that will cause a deflection of *10 divisions* in the meter reading. [2 marks]

(c) A magnetic testing circuit as shown in **Figure Q2(c)** is used to measure magnetic property of a ring specimen, that has a mean length of *30cm*. The ballistic galvanometer (BG) with a constant of $140\mu C$ per scale division is used in the measurement. The search coil has 80 turns and cross-sectional area of $3.5cm^2$. The resistance of the secondary circuit is 10Ω. Meanwhile, in the primary circuit, current of *5A* flows in the magnetizing coil of *100 turns*. As the reversal switch RS is on, the BG shows a deflection of *64 divisions*.

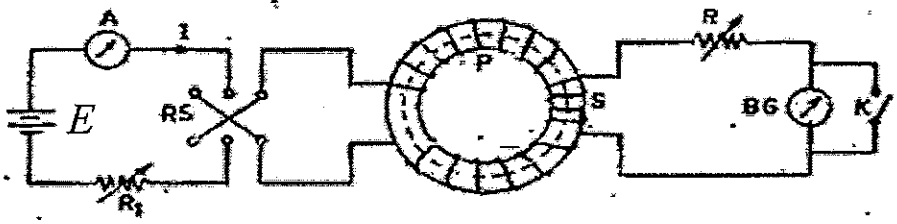

Figure Q2(c)

i) Calculate the applied magnetizing force, *H* [2 marks]

ii) Determine the flux density, *B* in the specimen. [2 marks]

iii) Calculate the relative permeability, μ_r of the specimen. [3 marks]

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Question 3

(a) A Wheatstone bridge circuit shown in **Figure Q3(a)** has resistances of $R_1 = R_2 = R_3 = 1k\Omega$ and $R_4 = 500\Omega$. A $12V$ supply is connected to the bridge circuit. If a galvanometer having an internal resistance of 167Ω is connected to the circuit, find the offset current. [5 marks]

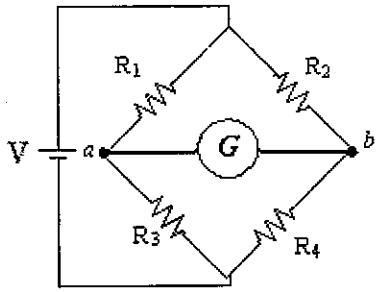

Figure Q3(a)

(b) An Maxwell Wien Bridge shown in **Figure Q3(b)**, includes a capacitor C_1 of capacitance $0.1\mu F$ in parallel with a resistor R_1 of 500Ω in arm AB. Arms BC and AD have one resistor each, R_2 of $1k\Omega$ and R_4 of 200Ω, respectively.
If R_1, R_2, R_4 and C_1 each has a limiting error of $\pm 1\%$. Find the maximum possible error values for R_S and L_S. (Show working steps in deriving the equations for R_S and L_S) [10 marks]

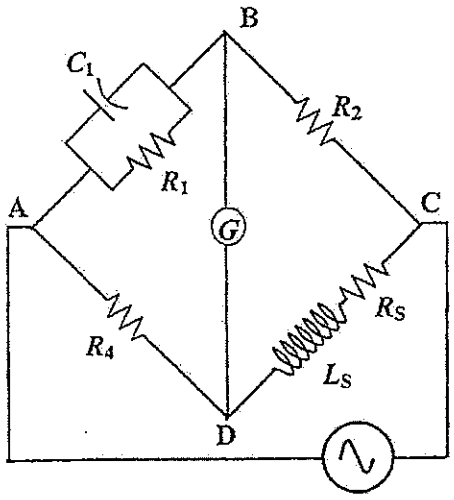

Figure Q3(b)

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Question 4

(a) A balanced 3-phase star connected system is shown in **Figure Q4(a)** below. Given that the magnitude of the line currents, $I_A = I_B = I_C = 2.37A$ and the load impedances, $Z_A = Z_B = Z_C = 100+j15\Omega$, calculate:

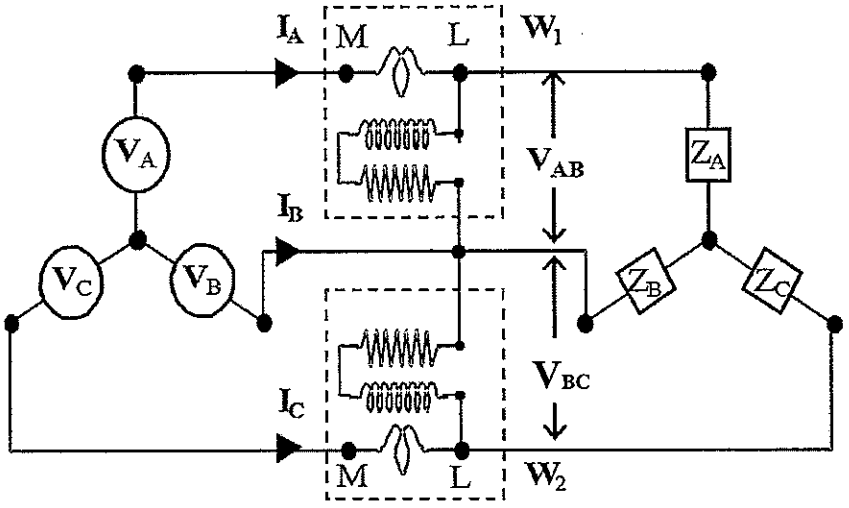

Figure Q4(a)

i) the line voltages, V_{AB} and V_{CB}. [2 marks]

ii) the powers recorded by each wattmeter, W_1 and W_2? [1.5 marks]

(b) A XYZ company states that its air conditioner only consumes at maximum 1kW of electricity power. However, an energy meter whose constant is *250rev/kWh*, registers *510 revolutions* when the air conditioner is turned on for *2 hours*.

i) Determine whether the air conditioner actually consumes less or more power from the above statement. [1.5 marks]

ii) From your technical point of view, give 2 possible reasons why the air conditioner consumes less or more power in Part (b)(i). [2 marks]

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(c) **Figure Q4(c)** shows a strain gauge:

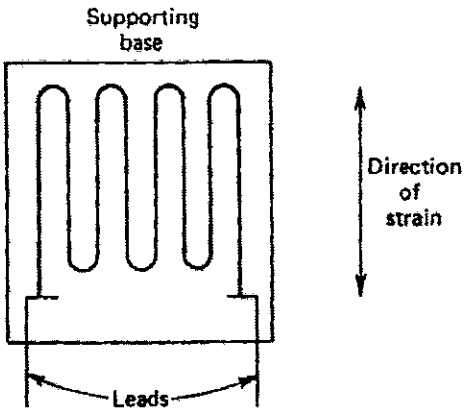

Figure Q4(c)

i) Explain the operation principle of a strain gauge. [2 marks]

ii) State ONE measurand (physical quantity) that can be measured using a strain gauge. [1 mark]

iii) How changes in ambient temperature cause inaccuracy in the strain gauge measurement? [2 marks]

iv) Using a suitable circuit diagram, explain the technique to compensate the ambient temperature effect on strain gauge measurement. [3 marks]

End of Paper